LISTING OF CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

1-117. (Cancelled).

118. (Currently Amended) A method executed in a computer system for producing a model of a combined physical system having physical quantities by representing physical quantities of the combined system in terms of partial differential equations, said method comprising:

representing each of a plurality of systems as an application mode modeling in up to three space dimensions said physical quantities of ~~said~~ each system, wherein said application modes are configured to model said physical quantities of at least one of a structural system, a fluids system, and an electromagnetic system;

determining, using a processor, a representation of a partial differential equation for each application mode corresponding to one of said plurality of systems using at least one non-local coupling, said at least one non-local coupling determining a value in at least one portion of a domain depending on a value from at least one other portion of a domain, parameters of said partial differential equations being physical quantities of corresponding ones of said plurality of systems;

determining, using said processor or another processor, a solution to said ~~a~~ model of said combined physical system using said partial differential equations corresponding to said plurality of systems, said model representing a mathematical expression of said physical quantities of said combined physical system; and

storing in a computer readable memory or in a computer readable data storage system said solution to said model.

119. (Previously Presented) The method of Claim 118 wherein said non-local coupling defines a value from a first domain in a first geometry to another domain in a second geometry.

120. (Previously Presented) The method of Claim 119, further comprising: forming, for each of said first and second geometries, a system of partial differential equations each having associated coupling variables.

121. (Previously Presented) The method of Claim 119, wherein at least one of said partial differential equation systems uses at least one local coupling.

122. (Previously Presented) The method of Claim 119, wherein said first and second geometries are the same.

123. (Previously Presented) The method of Claim 119, wherein said first and second geometries are different.

124. (Previously Presented) The method of Claim 118, further comprising: defining a non-local coupling wherein a value of a quantity on a boundary of a first domain is referenced on parallel lines extending into said first domain.

125. (Previously Presented) The method of Claim 119, further comprising: defining a non-local coupling in which a boundary condition associated with said first domain is defined using a value of an integral over a portion of one of: said first domain and said second domain.

126. (Previously Presented) The method of Claim 118, further comprising: defining a non-local coupling using at least one of: a mapped variable and an integrated variable.

127. (Previously Presented) The method of Claim 121, further comprising: defining a local coupling using at least one of: a basic variable, an auxiliary variable, and a glued variable.

128. (Previously Presented) The method of Claim 118, further comprising:

defining a non-local coupling variable using at least one of: an extrusion variable, a projection variable, and a scalar coupling variable.

129. (Previously Presented) The method of Claim 118, further comprising:

determining a stiffness matrix by determining at least one of a Jacobian of a variable and a value of a variable in accordance with a type of said variable wherein said combined system of partial differential equations is in weak form, said stiffness matrix being a Jacobian matrix of a residual vector with respect to a number of degrees of freedom, said Jacobian of a variable being represented as at least one contribution determined in accordance with a number of degrees of freedom; and

determining said residual vector by determining at least one of a Jacobian of a variable and a value of a variable in accordance with a type of said variable wherein said combined system of partial differential equations is in weak form.

130. (Previously Presented) The method of Claim 129, further comprising:

converting said combined system of partial differential equations from general form to weak form.

131. (Previously Presented) The method of Claim 129, wherein said determining said stiffness matrix further comprises:

determining at least one of a Jacobian of a variable and a value of a variable in accordance with points included in a quadrature formula and with other points in accordance with coupling variables.

132. (Previously Presented) The method of Claim 131, wherein said determining said residual vector further comprises:

determining at least one of a Jacobian of a variable and a value of a variable in accordance with points included in a quadrature formula and with other points in accordance with coupling variables.

133. (Previously Presented) The method of Claim 118, further comprising:

determining a value of a variable in accordance with a type of said variable used in at least one of said partial differential equation systems.

134. (Previously Presented) The method of Claim 133, wherein variables are recursively evaluated in accordance with variable type.

135. (Previously Presented) The method of Claim 134, wherein said determining a value of a variable in accordance with a type is used in determining at least one of a: stiffness matrix, constraint matrix, residual vector and a constraint residual vector.

136. (Previously Presented) The method of Claim 135, wherein said type is one of: a basic variable, an auxiliary variable, a glued variable, a mapped variable, and an integrated variable.

137. (Previously Presented) The method of Claim 118, further comprising:

determining a Jacobian of a variable in accordance with a type of said variable used in at least one of said partial differential equations wherein said Jacobian of a variable is represented in accordance with a number of degrees of freedom.

138. (Previously Presented) The method of Claim 137, wherein a Jacobian of a variable is recursively evaluated in accordance with variable type.

139. (Previously Presented) The method of Claim 138, wherein said determining a Jacobian of a variable in accordance with a type is used in determining at least one of: a stiffness matrix, a residual vector, constraint residual vector, and a constraint matrix.

140. (Previously Presented) The method of Claim 139, wherein said type is one of: a basic variable, an auxiliary variable, a glued variable, a mapped variable, and an integrated variable.

141. (Previously Presented) The method of Claim 118, wherein said at least one non-local coupling includes a variable having a dependency on another variable at at least one distant point.

142. (Previously Presented) The method of Claim 141, wherein said other variable is in the same geometry as said variable.

143. (Previously Presented) The method of Claim 141, wherein said other variable is in a different geometry from said variable.

144. (Previously Presented) The method of Claim 121, wherein said local coupling includes a variable having a dependency only on values of other variables at the same point.

145. (Previously Presented) The method of Claim 118, further comprising:

defining a non-local coupling used in at least one of a: subdomain, boundary, edge, and point that obtains a value at one of: a subdomain, boundary, edge, and point.

146. (Previously Presented) The method of Claim 121, further comprising:

defining a local coupling using at least one of: an expression variable and a boundary coupled variable.

147. (Previously Presented) The method of Claim 118, further comprising:

defining a non-local coupling wherein a value of an integral of a variable along parallel lines extending into a first domain is used on a boundary on said first domain.

148. (Previously Presented) The method of Claim 118, further comprising:

defining a boundary condition on one boundary in terms of a value of a variable on another boundary wherein said value is mapped in accordance with a coordinate transformation.

149. (Previously Presented) The method of Claim 118, further comprising:

defining a boundary condition in terms of a variable defined at a single point.

150. (Currently Amended) A computer readable medium having computer executable instructions stored thereon which when executed by at least one processor cause the processor to accomplish steps comprising:

representing each of a plurality of systems as an application mode modeling ~~in up to three space dimensions~~ said physical quantities of ~~said~~ each system, wherein said application modes are configured to model said physical quantities of at least one of a structural system, a fluids system, and an electromagnetic system;

determining, using said processor or another processor, a representation of a partial differential equation system for each application mode corresponding to one of said plurality of systems using at least one non-local coupling, said at least one non-local coupling determining a value in at least one portion of a domain depending on a value from at least one other portion of a domain; and

outputting a model by forming a combined system of partial differential equations using partial differential equation systems associated with said plurality of systems, wherein said output of said model is configured to be stored in a computer readable memory or in a computer readable data storage system.

151 . (Previously Presented) The computer readable medium of Claim 150, wherein said non-local variable defines a value from a first domain in a first geometry to another domain in a second geometry.

152. (Previously Presented) The computer-readable medium of Claim 151, further comprising:

forming, for each of said first and second geometries, a system of partial differential equations each having associated coupling variables.

153. (Previously Presented) The computer readable medium of Claim 151, wherein at least one of said partial differential equation systems uses at least one local coupling.

154. (Previously Presented) The computer readable medium of Claim 151, wherein said first and second geometries are the same.

155. (Previously Presented) The computer readable medium of Claim 151, wherein said first and second geometries are different.

156. (Previously Presented) The computer readable medium of Claim 150, further comprising:

defining a non-local coupling wherein a value of a quantity on a boundary of a first domain is referenced on parallel lines extending into said first domain.

157. (Previously Presented) The computer readable medium of Claim 151, further comprising:

defining a non-local coupling in which a boundary condition associated with said first domain is defined using a value of an integral over a portion of one of said first domain and said second domain.

158. (Previously Presented) The computer readable medium of Claim 150, further comprising:

defining a non-local coupling using at least one of: a mapped variable and an integrated variable.

159. (Previously Presented) The computer readable medium of Claim 153, further comprising:

defining a local coupling using at least one of: a basic variable, an auxiliary variable, and a glued variable.

160. (Previously Presented) The computer readable medium of Claim 153, further comprising:

defining a non-local coupling variable using at least one of: an extrusion variable, a projection variable, and a scalar coupling variable.

161. (Previously Presented) The computer readable medium of Claim 150, further comprising:

determining a stiffness matrix by determining at least one of a Jacobian of a variable and a value of a variable in accordance with a type of said variable wherein said combined system of partial differential equations is in weak foam, said stiffness matrix being a Jacobian matrix of a residual vector with respect to a number of degrees of freedom, said Jacobian of a variable being represented as at least one contribution determined in accordance with a number of degrees of freedom; and

determining said residual vector by determining at least one of a Jacobian of a variable and a value of a variable in accordance with a type of said variable wherein said combined system of partial differential equations is in weak form.

162. (Previously Presented) The computer readable medium of Claim 161, further comprising:

converting said combined system of partial differential equations from general form to weak form.

163. (Previously Presented) The computer readable medium of Claim 161, wherein said determining said stiffness matrix further comprises:

determining at least one of a Jacobian of a variable and a value of a variable in accordance with points included in a quadrature formula and with other points in accordance with coupling variables.

164. (Previously Presented) The computer readable medium of Claim 151, wherein said determining said residual vector further comprises:

determining at least one of a Jacobian of a variable and a value of a variable in accordance with points included in a quadrature formula and with other points in accordance with coupling variables.

165. (Previously Presented) The computer readable medium of Claim 150, further comprising:

determining a value of a variable in accordance with a type of said variable used in at least one of said partial differential equation systems.

166. (Previously Presented) The computer readable medium of Claim 165, wherein variables are recursively evaluated in accordance with variable type.

167. (Previously Presented) The computer readable medium of Claim 166, wherein said determining a value of a variable in accordance with a type is used determining at least one of a: stiffness matrix, constraint matrix, residual vector and a constraint residual vector.

168. (Previously Presented) The computer readable medium of Claim 167, wherein said type is one of: a basic variable, an auxiliary variable, a glued variable, a mapped variable, and an integrated variable.

169. (Previously Presented) The computer readable medium of Claim 150, further comprising:

determining a Jacobian of a variable in accordance with a type of said variable used in at least one of said partial differential equations wherein said Jacobian of a variable is represented in accordance with a number of degrees of freedom.

170. (Previously Presented) The computer readable medium of Claim 169, wherein a Jacobian of a variable is recursively evaluated in accordance with variable type.

171. (Previously Presented) The computer readable medium of Claim 169, wherein said determining a Jacobian of a variable in accordance with a type is used in determining at least one of: a stiffness matrix, a residual vector, constraint residual vector, and a constraint matrix.

172. (Previously Presented) The computer readable medium of Claim 171, wherein said type is one of: a basic variable, an auxiliary variable, a glued variable, a mapped variable, and an integrated variable.

173. (Previously Presented) The computer readable medium of Claim 157, wherein said at least one non-local coupling includes a variable having a dependency on another variable at at least one distant point.

174. (Previously Presented) The computer readable medium of Claim 173, wherein said another variable is in the same geometry as said variable.

175. (Previously Presented) The computer readable medium of Claim 173, wherein said other variable is in a different geometry from said variable.

176. (Previously Presented) The computer readable medium of Claim 159, wherein said local coupling includes a variable having a dependency only on values of other variables at the same point.

177. (Previously Presented) The computer readable medium of Claim 157, further comprising:

defining a non-local coupling used in at least one of a: subdomain, boundary, edge, and point that obtains a value at one of: a subdomain, boundary, edge, and point.

178. (Previously Presented) The computer readable medium of Claim 159, further comprising:

defining a local coupling using at least one of: an expression variable and a boundary coupled variable.

179. (Previously Presented) The computer readable medium of Claim 151, further comprising:

defining a non-local coupling wherein a value of an integral of a variable along parallel lines extending into a first domain is used on a boundary on said first domain.

180. (Previously Presented) The computer readable medium of Claim 157, further comprising:

defining a boundary condition on one boundary in terms of a value of a variable on another boundary wherein said value is mapped in accordance with a coordinate transformation.

181. (Previously Presented) The computer readable medium of Claim 151, further comprising:

defining a boundary condition in terms of a variable defined at a single point.

182. (Previously Presented) The method of Claim 118 wherein said representing of said plurality of systems as an application mode further includes modeling said physical quantities of said systems in a time dimension.

183. (Previously Presented) The method of Claim 150 wherein said representing of said plurality of systems as an application mode further includes modeling said physical quantities of said systems in a time dimension.

184. (Currently Amended) A method executed in a computer apparatus for creating a model of a combined physical system having physical quantities by representing physical quantities of the combined physical system in terms of a combined set of partial differential equations, the method comprising:

representing at least one of a plurality of systems~~, having up to three space dimensions,~~ as two or more selected application modes modeling physical quantities of the at least one of the plurality of systems, wherein at least one of the two or more selected application modes is configured to model said physical quantities of at least one of a structural system, a fluids system, and an electromagnetic system;

determining a set of partial differential equations for each of the two or more selected application modes, parameters of the partial differential equations being physical quantities of corresponding ones of the plurality of systems;

forming the combined set of partial differential equations using the determined sets of partial differential equations associated with the at least one of the plurality of systems;

determining, using a processor or another processor, a solution to the model of the combined physical system based on the combined set of partial differential equations for the two or more selected application modes for the at least one of the plurality of systems, the model representing a mathematical expression of the physical quantities of the combined physical system; and

storing in a computer readable memory or in a computer readable data storage system the solution to the model.

185. (Previously Presented) The method of Claim 184 wherein said representing of said at least one of said plurality of systems as two or more selected application modes further includes modeling said physical quantities of said at least one of said plurality of systems in a time dimension.

186. (Currently Amended) A computer readable medium having stored thereon instructions for creating a model of a combined physical system having physical quantities by representing physical quantities of the combined physical system in terms of a combined set of partial differential equations comprising machine executable code which when executed by at least one processor, causes the processor to perform steps comprising:

representing at least one of a plurality of systems as two or more selected application modes modeling physical quantities of said at least one of said plurality of systems, wherein said application modes are configured to model physical quantities of at least one of a structural system, a fluids system, and an electromagnetic system;

determining a set of partial differential equations for each of said two or more selected application modes, parameters of said partial differential equations being physical quantities of corresponding ones of said plurality of systems;

forming said combined set of partial differential equations using sets of partial differential equations associated with said at least one of said plurality of systems;

determining, using said at least one processor or another processor, a solution to said model of said combined physical system based on said combined set of partial differential equations for said two or more selected application modes for said at least one of said plurality of systems, said model representing a mathematical expression of said physical quantities of said combined physical system; and

outputting said solution to said model in a format configurable for display on a graphical user interface.

187. (Previously Presented) A method executed in a computer system for creating a model of a combined physical system having physical quantities by representing physical quantities of the combined physical system in terms of solving a set of partial differential equations comprising:

defining a plurality of user-defined application modes modeling physical quantities of an associated model having up to three space dimensions, wherein the application modes are configured to model the physical quantities of at least one of a structural system, a fluids system, and an electromagnetic system;

selecting two or more of the user-defined application modes;

determining, using a processor, sets of partial differential equations for the selected two or more user-defined application modes of the associated model, parameters of the partial differential equations being physical quantities of an associated model;

determining, using the processor or another processor, a solution to the model based on a combination of the determined sets of partial differential equations for the two or more selected user-defined application modes for the associated model, the model representing physical quantities of the combined physical system;

storing in a computer readable memory or in a computer readable data storage system the solution to the model; and

outputting the solution to the model in a format configurable for display on a graphical user interface.

188. (Previously Presented) The method of Claim 187 wherein the application modes are further configured to model the physical quantities in a time dimension.

189. (Currently Amended) A computer readable medium having stored thereon instructions for creating a model of a combined physical system having physical quantities by representing physical quantities of the combined physical system in terms of solving a system of partial differential equations comprising machine executable code which when executed by at least one processor, causes the processor to perform steps comprising:

defining a plurality of user-defined application modes modeling physical quantities of an associated model, wherein the application modes are configured to model the physical quantities of at least one of a structural system, a fluids system, and an electromagnetic system;

selecting two or more of the user-defined application modes;

determining sets of partial differential equations for said selected two or more user-defined application modes of said associated model, parameters of the partial differential equations being physical quantities of corresponding systems; and

determining, using said at least one processor or another processor, a solution to the model based on a combination of the determined sets of partial differential equations for the two or more selected user-defined application modes for the associated model, the model representing a mathematical expression of the physical quantities of the combined physical system.